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☞ This number contains some articles which may appear out of place—bearing date subsequent to the date of the number. This arises from the circumstance that, when the undersigned took charge of the publication of the Journal, late in April, he found it behind time—and being aware of the effort necessary to overhaul a locomotive under way, he deemed it the better plan to run a "train" in both directions until the work should be "up to time" and a little in advance.

To be able to keep it always in advance, he relies much, very much, upon those whose interests are so closely identified with the improvement, and extension of the railroad system in the United States. We ask from every Engineer the result of his experience; and from every friend of railroads, his co-operation in giving circulation to the Journal. To the present subscribers who have, through good report and through evil report, stood by the work, and sustained it as well by their contributions to its pages as by the prompt payment of their annual subscription, he tenders his hearty thanks. And to those who have, like himself, and the railroad cause, for a few years past, been "off the track," he would say, be of good cheer—our turn is coming next. Let us lift together—sustain the Journal and it shall labor to sustain the cause. To the press, for its kindness, he is truly grateful for the past, and trusts that the Railroad Journal will continue to merit and receive its favorable notice.

D. K. MINOR.

IMPORTANCE OF RAILROADS, ESPECIALLY IN THE UNITED STATES.

We find in the New York American the following article from the Cincinnati Daily Chronicle, in relation to the present condition and future prospects of the United States. Assuming the past as a criterion for the future, we may look forward to a condition of things in this country truly sublime to contemplate. *One hundred* years ago and what were we? what are we now? and *what may not we be*, if we will, *one hundred years hence?* In 1743, there was scarcely a *million* of inhabitants within the territory now claimed by the United States, estimated to contain 2,200,000 square miles. Now, in 1843, there is about 18 millions, and it is safe to estimate that in 1943, there will be over 300 millions, indeed Darby estimates the population of 1940, at 386 millions; but say 300,000,000 of inhabitants within our present territory, reaching from the Atlantic to the Pacific, and from Canada to the Gulf of Mexico, embracing almost every variety of soil, and temperature of climate.

We may travel thousands of miles, in a direct line, without crossing our own boundaries; and over a more fertile soil than can be found elsewhere. We have rivers longer, and larger in the aggregate, and furnishing a better navigation than any other country on the globe. Our lakes would by others be called seas. We have a more intelligent, more enterprising and more prosperous population than can be found under any other government; of

course our *movement* is *onward*—our *progress rapid* and our *destiny* truly *sublime*—who can estimate it?

With such elements of prosperity, we must progress with a rapidity astonishing to calm observers under other influences; indeed astonishing to ourselves; and it becomes us as intelligent citizens to look well to the course which we mark out for ourselves. It is not yet 26 years since the first sod was upturned for the Erie canal. Only a *quarter* of a century, and still it is a great *great grandfather*, with a progeny "too numerous to mention," besides its *illegitimate* offspring, railroads, into whose hands the septre has fallen, and by which we are to progress hereafter at railroad speed, with locomotive power, on a level road, or gently ascending grade, until the different States of the Union are so intimately connected that *disolution* will be *impossible.* The past quarter of a century has been productive of important results. We have accomplished more in that period, in the way of improvement, and increase of facilities for the transaction of business, than was accomplished during a *century* previous. We are now somewhat in the condition of the student who has taken his degree at college—just prepared to begin to learn to *advantage*. We have studied some, practised more, and made some great mistakes, and are now in a better condition to *learn* than at any former period. Necessity requires us to proceed, the march is onward, and if we remain stationary, the *train*, *locomotive*, *tender*, *cars*, and all will pass over us. In other words, we shall fall behind the age. How important then that from this time we proceed on correct principles. Let us reason from the past and present to the future, and when we do resume our works of improvement in earnest, let us commence on the *main* lines and carry them forward gradually, but steadily towards the great points on the Mississippi at St. Louis, which is ultimately to become a large city; and north to the *Canadas* for defence, and the *latteral* roads, diverging to minor, but still important points, will follow as a matter of course.

The progress of population is so wonderful, and the causes of excitement and controversy are such that, with all the efforts of a wise conservative policy, we can hardly expect to maintain peace for a quarter of a century to come. There is a constant tendency among us to controversy. Uneasy spirits, with nothing but life, which is apparantly of little consequence in their own estimation, to loose, and everything to gain, a war with Great Britain is almost inevitable. And, therefore, it is of vast importance that we have main lines of permanent railroad, extending from the principal cities to the *interior*, to the *frontier*, to the *far west*, that troops, provisions, and munitions of war may be transported rapidly from place to place, and thus, by rapid movement, and unexpected blows, accomplish much in little time and with comparatively small means.

The economy in money alone, to say nothing of *health* and *life*, during even a short war like our last, would construct more than a *thousand* miles of railroad, of the first class, in this country, or a line from New York to St. Louis; and such a railroad would be equal, at least in the defence of our

9,500 miles of border line, to a regular army of 20,000 men, as, by it, troops could be collected from *eight* or *ten* States, at any point on its line, or at either extreme, in *three* to *five* days, thus *concentrating* or *distributing* a force wherever needed, which might bid defiance to any power on earth likely to attack us.

But the advantages of railroads, as a means of defence, great as they unquestionably are, are mere trifles in comparison with their benefits as a means of social intercourse and *union* among ourselves. Connect distant points by railroad, no matter how different the habits, manners and views of the people, they will soon become acquainted, and eventually assimulated and neighbors; thus dispelling prejudices and cementing friendships, calculated to perpetuate the institutions under which we have risen from a mere handful, and are *growing to be* the *mightiest* nation on earth. We are destined to become, if we remain *united*, and are *wisely* governed, the most powerful nation on earth, from the fact that we have the largest *fertile* territory in one body, with the greatest natural facilities for navigation in our numerous mighty rivers and lakes, and the most enterprising and intelligent people as a mass. Then how important that our improvements should progress under wise counsels, that we may keep pace with the spirit of the age, and find employment and sustenance for the coming millions predicted in the following article.

GROWTH AND POWER OF THE UNITED STATES.

Since the complete establishment of the American constitutional governments, the future growth and ultimate power of the United States has been a problem both with philosophers and political economists. There are two strongly exciting causes to this species of speculation. The first to discover the effect of the freest institutions mankind had ever adopted on the happiness and prosperity of the people under their influence; and the next to discover the natural growth of the only nation which, since the earliest ages of the world, has been left undisturbed in its natural progress. Half a century has not wholly determined these problems, beyond a contingency; but it has furnished us with some elements of the ultimate result. Those especially, which relate to physical growth and power, may be regarded as leading to certainties of result, beyond any disturbing causes, except that of Divine Providence. This future prospect is important, in considering our relations with other nations, and in determining our national policy. For this cause, we propose to take a birdseye view of the natural capabilities of the United States.

The surface of the United States comprehends a space of about two millions two hundred and fifty thousand square miles, and is about *one-twentieth part of the land surface of the earth.* More than one-half of this surface lies between the 35th and 45th degrees of latitude. It is, therefore, in the very heart of the temperate zone, where nature brings man and fruits to the highest measure of comparative excellence.

The circumference or border line of the United States is about *nine thousand five hundred miles in length.* It may be divided thus:

Boundary, in common with British N. America, about	3,700	miles,
Boundary, in common with Mexico,	2,300	"
Coast of the Pacific,	700	"
Coast of the Gulf of Mexico,	1,000	"
Coast of the Atlantic,	1,800	"
Total,	9,500	"

The territory thus enclosed includes also ***nearly ten thousand miles of lake and river navigation***, of which two-thirds are in the valley of the Mississippi. The great lakes make a chain of about two thousand miles; the Mississippi two thousand more; the Missouri two thousand more; the Ohio nearly one thousand; and hundreds of minor streams from the St. Croix to the Sabine, make up thousands more.

It is important to observe, that this extensive country is admitted by geographers of former nations to have the most various soil, climate and productions of any country upon the globe. The inevitable consequence is, that its capabilities for population and wealth are correspondingly great. No country can surpass it in the capacity for production.

Of the whole two millions two hundred thousand square miles of surface, only about two hundred and fifty-five thousand lie in the Atlantic slope, and two-thirds of the whole lie in the valley of the Mississippi. To estimate rightly the population, which, under the natural and known laws of increase, will arise and be readily maintained on this surface, it is necessary, first, to consider for a moment the *arability and fertility* of the Mississippi basin.

The first fact we observe is, that the rivers of this basin are remarkably long. For example, the main stream of the Mississippi rises near latitude 48 degrees and joins the Gulf of Mexico about 29 degrees—thus running through about 20 degrees of latitude.

The Red river, of Louisiana, is estimated by Mr. Darby at one thousand miles in length. The Ohio, on the eastern side, is also one thousand, ascending to the heads of the Monongahela and Allegheny. The result of this is of vast importance. The rains and melted snows, which occasion the annual floods, fall on distant mountains, and raise those streams to great heights, pouring forth a vast volume of water. In proportion to the length of rivers, and their annual rise, must necessarily be the alluvial lands they feed. This is sufficiently illustrated by the river Nile, whose annual floods, coming from the distant mountains of Africa, occasion the fertility of Egypt.

In connection with this fact, we have nothing of equal consequence; that in this vast region there is very little space occupied by mountains, marshes. or lakes, incapable of production. Almost the whole surface is *arable*. These great facts, taken in connection with its locality in the midst of the temperate zone, determine the conclusion, that this great American basin is capable of producing more grain, and consequently, maintaining more people, than any other equal space on earth. So far as our cultivation has extended, the practical result corresponds with this theory, deduced from geographical facts.

The question of American population has become of great interest to speculators on the future progress and condition of the human family; for heretofore, the United States has populated with a rapidity beyond any conceptions which have been formed from the basis of European statistics. In the various estimates which have been made of the progress of American population, there are two, particularly worthy of notice. One by Darby, in a most excellent work, "View of the United States;" and the other by Professor Tucker, in Hunt's Merchants' Magazine.

Mr. Darby's estimate was made before the census of 1830, and is therefore subject to two tests:

	Estimate.	*Reality.*
1830	14,093,000	12,866,000
1840	10,335,000	17,063,000

But an important fact is to be noticed. The greatest error in Mr. Darby's

estimate was in the number of *slaves*, which according to his estimate would

have been in 1840,	4,114,000
But were in fact,	2,487,000

a difference of estimate equal to more than one-half the whole number of slaves. It is to be observed that this *over estimate* of the growth of the slave population has pervaded the calculations of all writers on the subject. They have never allowed enough for the two great *slave checks*, emancipation and bad condition. Mr. Darby proceeds to make an estimate for each year till 1940, one century from this time. The following are some of the results:

1860	35,167,000
1900	115,000,000
1940	386,000,000

Professor Tucker, in his calculations, published in Hunt's Merchants' Magazine, assumes that the ratio by which our population has increased will not long continue the same, but will gradually diminish as the number of persons increase to the square mile. This is mere matter of speculation; but when the people have become very dense, undoubtedly this is true; but as each new State is as fresh and fruitful as the oldest was, this check will not happen very soon. It is to be observed that the increase from 1830 to 1840 was $32\frac{1}{3}$ per cent., which doubles in little more than twenty-four years. This ratio on the population extant one hundred years ago, will give the present actual result. So that this is the real natural increase of the American population. Professor Tucker's calculations give these results:

1900	80,000,000
1940	200,000,000

Comparing the estimates of Darby and Tucker, and taking the mean it may be considered certain that, without Divine interposition to the contrary, one century will increase the population of the United States to *three hundred millions.*

It may be interesting to know the ultimate *capabilities* of the American territory. Ireland contains eighteen thousand six hundred miles square of surface, and eight millions of persons. Notwithstanding this density of population, Ireland has yet a great deal of waste land. It is certain that the United States can contain as great a proportional population as Ireland. Take the same proportion, and it gives the United States an ultimate capacity of containing *eight hundred millions of people*—more than the entire population of the globe! In a historical point of view, the period may not be long before that prodigious result is reached; for in history, two or three centuries is not a very great portion of time. There is nothing in all this for the people of the United States to make a boast of; but there is much for gratitude, and much for contemplation.

The present generation will never see these astonishing results; but they are doing what will certainly influence widely these advancing millions. We do not believe that political society admits of much reformation in its old age, which was not attempted in its youth, any more than an old man is apt to change the habits of his life. The foundations we wish this vast political society to stand upon, we ought to have not only laid, but most firmly built up at this very time. In vain do we grow, if we grow not wisely. The power which the United States must have to maintain a happy liberty, is an intelligent moral power. They must do right and do right intelligently. The great levers of this power are the school, the press, and the church. The school needs to be more elevated, the press to be purer and better. Can we not attain a higher and a better standard?

AMERICAN RAILROAD IRON.

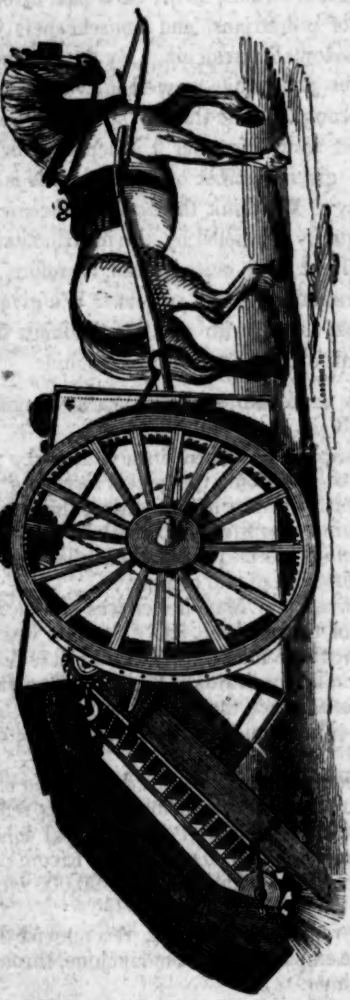
When on a visit to the *Albany iron and nail works*, under the management of John F. Winslow, Esq., near Troy, a few days since, we were gratified to observe that, notwithstanding the general depression of the business of the country, the proprietors of this establishment were enlarging their works preparatory to a more extensive business.

The manufacture of iron from the *pig* into nearly all its various forms, is carried on in this establishment, and then into *nails*, ship and boat *spikes*, and various other articles. We also discovered in our rambles—which were without a guide or any one to explain the half we saw, to advantage—through this extensive manufactory, that the manufacture of *steel* is carried on to a considerable extent, and we were shown, and now have in our office, a specimen of *files*, the manufacture of which has recently been commenced by Mr. Winslow.

But the information obtained which pleased us most was, that Mr. Winslow is ready to receive orders for the manufacture of *railroad iron*. The introduction of this branch of manufacture will be of immense advantage to this country. We have sent abroad within twelve years, more than thirty millions of dollars for railroad iron alone, which ought to have been paid to our own iron manufacturers. We have the materials of the very best quality, and we have also the *skill*, and the *enterprize*, and the *capital* to work them; but, unfortunately, there has not been given to it the attention necessary to perfect *machinery*, to enable us to compete with foreign cheap labor. It is idle to say we cannot do it. We *can* do it, and *shall* do it. Let those who have already done so much to elevate American character, in the improvement of American machinery, give their attention to the manufacture of railroad iron, as they have to other important subjects, and we shall ere long be able to supply the demand for railroad iron in this country from our own mines. If Mr. Winslow and his associates will give to the subject that attention which its importance demands, and overcome the *imaginary* as well as the real difficulties in the manufacture of railroad iron, they will be entitled to the thanks, the gratitude, and what is far more important, the *patronage* of their countrymen. And we shall be gratified if we can in any way promote their interest in this new effort to promote American manufactures. The *present* is perhaps the most fortunate period possible for them to undertake an enterprize so important. Capital in abundance, price of labor low, everything cheap, and the *energies* of the country rapidly assuming an elasticity which will surely give impetus to the railroad system, and carry out many an important enterprize projected and commenced years ago, but suspended by the *tornado* which swept over the land, and prostrated many a sturdy oak of rapid growth, whose branches had expanded more rapidly than its roots. The time is, however, at hand when many a tree, whose branches have for years been leafless, and whose roots have been upturned and withering under the scorching blasts of a baneful *sirocco*, will again take root and flourish and become, under a more careful culture, the pride of

the forest. We therefore say to the gentlemen of the "Albany iron and nail works," God speed you in your new enterprize. May you be successful, and derive a profit from the enterprize at least equal to the benefits which we hope may result to the country from the example.

STREET SWEEPING MACHINE.



WHITWORTH'S PATENT STREET SWEEPING MACHINE.

We gave, in the June number, a description, accompanied by a wood engraving, of Whitworth's street sweeping machine; which we found in the Civil Engineer and Architects' Journal for April. This machine has been introduced into use in Manchester, and after more than a year's experience in an extensive district, it has been found to answer well, and the commissioners of police recommend its use exclusively in the cleaning of streets in that city.

One of the machines has been sent to this city for trial, and has been used both in this city and Brooklyn, but not having the opportunity of seeing it in operation, we are unable to give an opinion as to its success, but of the entire practicability of the construction of a machine to clean our streets, *far more* thoroughly than it has ever been done, either under the old or the new system, we have not a doubt; and, if the testimonials accompanying the late report of the company using this machine in Manchester and its vicinity, extracts from which we give herewith, are to be relied on, as we doubt not they are, it is well worth the attention of our citizens, whose comfort, as well as interest will be greatly promoted by the use of machines with *wheels* instead of legs and *votes.* If a machine had *votes* in proportion to its superiority over the present mode of operation there would be no trouble in introducing it into use in every *city* and *village* in *this State;* and indeed it would not be singular if a few were sent out into the western wilds where some noble patriot has all the requisites, in his own estimation, except votes, to serve the dear people.

By the mode in use in this city during the past ten years, the loose dirt has been *stired* up, once or twice a week, in *dry* weather, but never disturbed when most troublesome, in *muddy* weather, thrown carelessly into carts, to be driven to the place of deposit, but owing to carelessness or design, no small portion of it is scattered to the four winds, as the carts pass through the streets, to the great annoyance of pedestrians, and housekeepers who are so thoughtless as to raise their windows for fresh air. By the new mode we understand that the work may be done quite as well in wet as in dry weather, and that it is much more thoroughly done than in the ordinary way, without dust in sweeping, and without scattering after it is deposited in the cart; and the expense of sweeping a given number of square yards is not half as much as in the ordinary way. We think the *health*, *convenience*, and *interest* of the citizens will be equally promoted by the introduction of *machine* sweeping in the streets of all our large cities. And, therefore, our efforts will be given to a better understanding of the subject. We give annexed, extracts from the company's last report, with other testimonials from witnesses competent to judge and speak of the merits of the machine.

EXTRACTS FROM THE REPORT OF THE ROAD AND STREET CLEANSING COMPANY.—MANCHESTER, FEBRUARY, 1843.

" The road and street cleansing company has been formed to carry into general operation throughout the united kingdom, the patent sweeping machine, invented by Mr. Joseph Whitworth, of Manchester. More than twelve months have elapsed since the machine was first set to work in that town, and during the greater part of that time it has been used throughout an extensive district, under the immediate direction of the company.

" In March, 1842, a part of the township of Manchester was assigned by the commissioners of police for trial of the machine, and a contract was entered into for working it therein during three months. The district included several principal thorougfares, and contained upwards of 30,000 square yards of street surface. By the terms of the contract, the surface was to be cleaned three times oftener than under the old system, for three-fourths of the cost, or at one-fourth the former rate.

" The district in question soon presented a striking contrast with the other parts of the town, and before the contract expired, a memorial for its renewal and extension, signed by more than one hundred of the principal inhabitants, was presented to the commissioners. The contract was accordingly renewed for twelve months, and the district extended to include 90,000 square yards.

" The late commissioners, in their report for last year, recommend their successors to prepare for the exclusive employment of the machine, throughout the township, after the close of winter.

" It has recently been introduced into the adjoining township of Chorlton-upon-Medlock, the whole of which, containing 171,000 square yards, is now held by the company under contract.

" The working of the machine in these districts, has afforded ample opportunity of testing its capabilities, and furnishing satisfactory data for general calculation. The following are some of the actual results obtained in Manchester.

From the 25th of June, 1842, to the 9th of February, 1843—8,162,000 square yards were swept in the enlarged district, containing 83,000 yards of

paved streets, and 7,000 yards of Macadamized surface. The time occupied, taken on the average, for two machines, was 6½ hours per day for sweeping and loading, and 2½ hours for carting to the depot yards and unloading. This for 188 (the number of working) days, gives an average per machine, of 21,702 yards per day of nine hours. During a considerable portion of the time, only one horse was worked in each machine. Moreover, the period from June to February, includes nearly the whole of winter, when the work is heavier than at any other season. The average amount of work by one machine, with two horses, in the above district, may, therefore, be fairly stated at 24,000 yards per day, or 7,200,000 yards per year, of 300 working days. This quantity is equal to the performance of more than 20 men on the present system, in sweeping alone.

"The quantity of sweeping which each machine can do per day, must of course depend in a great measure, on the provision made for deposit. In the above calculation nearly one-third of the whole time is allowed for transport and unloading, being the average proportion of time so occupied in the company's district. But this is a much larger proportion than would be necessary under a permanent system, embracing an entire town. The depot yards might be so arranged as to prevent any loss of time in transport, and the cleansing power of the machine would be proportionally increased. Where provision cannot be conveniently made in large towns for deposit in yards at proper intervals, the patent machine may be constructed of two parts, viz: an upper, carrying the sweeping apparatus, and a lower, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit.

"The average extent of surface swept by the patent machine for each load of street soil, has been about 4,000 yards. By the report of the police commissioners the average per load for the township of Manchester, in 1841, was 764 yards—a difference of more than 4 to 1, in the state of the same district, now, and at a former period.

"The result affords the most satisfactory and decisive evidence of the beneficial operation of the patent machine. It is also important, in reference to the required provision for deposit, showing that the depot yards may be placed more than two miles apart, while the time now occupied in transport, is saved to the machine.

"Sufficient opportunity has not yet been afforded to ascertain the amount of effect in promoting durability of street structure. But it is observed, that the streets swept by the machine, are dry after rain, long before those in the immediate neighborhood. The water rapidly finds its way to the channel, and has the effect of cleansing the surface of the pavement. The machine itself may be worked on pavement, during rain, with great advantage. The operation of cleansing is more effiiciently performed, and the water, which would lie in the hollows on the surface till evaporated, is at once removed. Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement. The cart when full is drawn to the side of the street, at some distance from a sewer grid, and the pipe-plug being withdrawn, the water flows into the channel.

"By a slight modification of the original form of the machine, it is enabled to sweep close up to the curb-stone, along the side of the street; and the hands before required to clean out the gutters, are dispensed with. The ac-

tion of the brooms is regulated with the greatest ease and nicety, according to the state of the weather, and the nature of the surface, by a series of weights, which counterbalance a certain portion of the weight of the sweeping apparatus, and relieve the pressure of the brooms on the ground. The brooms with the entire apparatus, may also be raised entirely from the ground, by means of a handle turned by the driver, whenever it is necessary to suspend the operation of sweeping, as, when the cart is full, or the surface obstructed. The same handle will raise the sweeping apparatus into the horizontal position, when access is required to the hinder part of the cart, for the purpose of unloading.

"No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface, the round and square set stone, the Macadamized road, and the wood pavement, all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention, and will, no doubt, tend to facilitate the general introduction of that useful invention.

"In Manchester, the average of the present rate varies from 3s. 6d. to 5s. per 1,000 yards. By the aid of the patent machine, it will be generally reduced to about 1s. In most places, however, the greater part of the pecuniary saving will be absorbed in more frequent cleansing, while the advantages resulting to the public will chiefly consist in the improved state of the thoroughfares, and the consequently improved condition of the people.

The following extract from the fourteenth annual report of the lamp, scavenging, etc., committee, Manchester, 1842, shows conclusively that this mode of sweeping is altogether superior to the previous mode.

"In 1838, 13½ millions superficial square yards of streets were swept, from which were carted away 39,409 loads of sweepings; last year, 21½ millions superficial square yards were swept, but only 25,029 loads had to be removed, amply proving, that the system of scavenging in operation during the above period, has effected a highly beneficial change in the cleanliness of the town, tending, not only to the prevention of infectious disease, but to the effecting of a considerable saving in the wear and tear of the pavements. These advantages have been realised still more fully in the district assigned to the 'road and street cleansing company,' under the contract reported to the commissioners, in July last, and if their machine proves as efficient in the winter, as it has up to this time, the committee recommend their successors to purchase or hire a sufficient number for the town, and to work them under the exclusive direction of the commissioners."

"*Street Sweeping Machine.*—We understand that Whitworth's 'patent cleansing machine,' which has been in operation in Manchester for the last ten months, and has given universal satisfaction, is about to be introduced into the Metropolis. Manchester, instead of being the dirtiest, is now, we believe, the cleanest of our large towns. The introduction of the machine here, induced a smart competition betwen it and the old force of sweepers; and, although the latter are unable to maintain that degree of cleanliness in their districts, which is accomplished by the machine in the one allotted to it, the general improvement in the town, over former years, is very striking. The difficulty of cleansing the crowded thoroughfares of London at this season of the year, by the old mode, appears almost insuperable; but we have no doubt, that the introduction of the machine there, will be attended with the same gratifying result we have witnessed here. The power of the machine is extraordinary, being equal to thirty men; and, in its operation,

the numerous annoyances which are inseparable from the old mode, are altogether avoided."

We could give numerous other extracts of a similar character, from foreign journals, but our object being merely to call attention to the subject, these will suffice—and with the following from the Tribune, and a cut representing the machine at work, we leave the subject for the present, with the remark, that if found in practice here, what it is represented to have been in Manchester, it will be put into use, even though the gentlemen of *Orange street*, may not altogether approve of it. We have *yet* to learn, that valuable improvements are to be discarded, or destroyed by a mob of those who have sought an asylnm among us from starvation and nakedness in their own country, simply because it may compel them to seek other employment.

The editor of the Tribune says, "An experiment was made yesterday in Chambers street, between Centre and Broadway, with the new 'street sweeping machine and self-loading cart,' which is of recent English invention, and has been hitherto entirely unknown in this country. The trial was made under the direction of C. J. Buchingham, Esq., the American agent of the patentee, and the machine used was one which he imported. Its operation was very successful, and fully illustrated the principle of the machine, which was all he intended to do, as those he proposes to build in this country will be improved in several essential particulars and be much lighter. A wide track was swept almost perfectly clean, the dirt being deposited in the cart and removed as the process of cleaning went on. No dust was raised, although the street was very dry; and the machine removes mud and stones with almost as much facility as ordinary dirt."

The London Architects' Journal for June says, that "The patent street cleansing machine of which we gave a detailed account in our April number has continued in daily operation in Regent street. All parties express themselves perfectly satisfied with its performance, and anxious to see it generally introduced. A public company is now forming for working the machine in the metropolis and its vicinity."

We shall be gratified to see this machine in successful operation, and to know that those interested are liberally compensated for their enterprize, but we give them warning that they may look out for competition if they are *thought* to be successful, as there is a great propensity in this country to out do other people, so great, indeed, that we not unfrequently out do ourselves.

The last report of Mr. Schlatter on the railroad from Harrisburg to Pittsburg having not yet received a notice in our Journal, we give in the present number several extracts from it. It would be impossible to follow out the details of the various routes without entering into local descriptions too minute and too extended to be of interest to the general reader.

A careful examination of this document has satisfied us of the immense amount of labor required to complete the thorough examination of the various routes. The result at which Mr. S. has arrived—a route remarkably direct between the termini, and at the same time presenting a more favorable grade than any other, when we consider the nature of the surface surveyed —may be esteemed one of the finest achievements of engineering science in our country.

We give the outline description of the preferred route with the cost of that line which adopts the most economical of the many sub routes given.

The report on the Chambersburg and Laughlinstown turnpike contains so much valuable information upon a neglected subject, that we have drawn largely from it.

There is also much that is useful in the principles laid down for the reduction of the routes to a level straight line, and this, together with the estimates of fuel etc., will be found highly interesting to engineers.

MIDDLE, OR PREFERRED ROUTE,

Which commences at the terminus of the Harrisburg and Lancaster railroad, at Harrisburg, and pursues the eastern shore of the Susquehanna river, to a point 4$\frac{82}{100}$ miles, above Harrisburg, where it crosses the river, and follows the western bank to the mouth of the Juniata river. Thence, the line is traced along the southern shore of the Juniata to a point two and a half miles below Lewistown, where it crosses the river and canal, and follows the valley of the Kishacoquillas creek to a point five and a half miles above Lewistown, where the creek is crossed. Thence, the line runs in a north-westerly direction, until it strikes the Stone mountain, the slope of which it ascends gradually to a point favorable for piercing the mountain by a tunnel; thence, crossing the head waters of Stone creek, and the dividing ground between Stone and Shaver's creeks, the line descends the valley of Shaver's creek, and continues along the southern slope of Tussy's mountain, until a point on the Little Juniata, five miles above the Juniata division of the Pennsylvania canal at Petersburg, is attained. Thence, following the valley of the Little Juniata to Logan's Narrows, (where the ascent of the Allegheny mountain commences,) the line is traced on the side of the mountain, ascending with gradients varying from a level to forty-five feet per mile, until the summit of the mountain is attained at Sugar Run Gap. From this Gap, the line descends the western slope of the mountain to the Black Lick creek, (near Ebensburg) which it follows to its junction with the Conemaugh, below Blairsville. Crossing the Conemaugh, a very direct course is pursued towards Pittsburg, the line crossing the Loyalhanna about two and a half miles north of New Alexandria, passing near the towns of New Salem and Murrysville, following the Turtle creek to its junction with the Monongahela river, and by this river to Pittsburg. The total distance from Philadelphia to Pittsburg, by the route surveyed last year, and by the Columbia and Harrisburg and Lancaster railroads, was found to be three hundred and forty-eight miles. The surveys of this year have reduced this distance to less than three hundred and thirty-seven miles, making a saving of more than eleven miles, without, in any instance, exceeding the maximum grade of the Philadelphia and Columbia railroad, viz: forty-five feet per mile.

Graduation, masonry, and bridging on two hundred forty miles and thirty-six hundredths, for a *single* track,	$3,973,785
Two hundred forty miles and thirty-six hundredths of superstructure, at $10,000 per mile,	2,403,600
Turnouts and passing places,	72,000
Depot, buildings, water stations, etc.,	60,000
Engineering, superintendence, etc.,	100,000
Right of way and land damages, $500 per mile,	120,180
	$6,729,565
Add 5 per cent, for contingencies,	336,478
	$7,066,043

As the connection of the public works of New York with those of Pennsylvania, by means of the Williamsport and Elmira railroad, and the northern route of the Harrisburg and Pittsburg railroad, is looked upon as being of the greatest importance to the interests of the Commonwealth of Pennsylvania, as the means by which a great amount of trade and travel will eventually be passed through our State to the sea-board at Philadelphia, I have prepared, according to your direction, an estimate of the cost of constructing the connection between the Williamsport an Elmira, and the Harrisburg and Philadelphia railroad.

The distance from a point opposite Williamsport to the railroad at Harrisburg is ninety-one and a half miles.

The graduation, masonry, and bridging for a double track in this distance has been estimated at	$828,996
Single track of railway, ninety-one and a half miles, at $10,000 per mile,	915,000
Land damages, buildings, water stations, turnouts, and double track where necessary,	100,750
	$1,837,646
For engineering and contingencies add ten per cent.,	183,764
	$2,221,410
If the graduation is formed for the reception of a single track, the cost of the connection will be reduced to	$1,785,974
The estimate for completing the Williamsport and Elmira railroad, furnished me by the engineer of the road, is	740,000
Total sum required to connect the New York and Erie railroad, the Buffalo and Boston railroads, and the Erie canal with Philadelphia,	$2,525,974

As the distances between all the points from Dunkirk to New York, and to Philadelphia, have been now ascertained by means of railroad routes, either in operation, partially constructed, or surveyed, it may not be irrelevant here to exhibit the situation of each point of importance upon the routes leading respectively from Dunkirk, on lake Erie, to New York and Philadelphia.

FROM PHILADELPHIA TO DUNKIRK BY CONTINUOUS RAILROAD.

From Broad st., in Philadelphia, to State st., in Harrisburg,	106¾ miles.
From Harrisburg to Williamsport, by northern route of Harrisburg and Pittsburg railroad,	91½ "
From Williamsport to Elmira, by Williamsport and Elmira railroad,	74 "
From Elmira to Dunkirk, by the New York and Erie railroad,	194 "
Total,	466¼ "

FROM NEW YORK TO DUNKIRK.

From New York to Piermont, by the Hudson river,	22 miles.
From Piermont to Elmira, by the N. York and Erie railroad,	252 "
From Elmira to Dunkirk.	194 "
Total,	468 "

From the foregoing statement, it appears that the distance from Dunkirk to New York is one mile and three-quarters greater than from Dunkirk to Philadelphia. This statement is believed to be correct, as the distances from Dunkirk to Elmira, and from Elmira to Piermont, were taken from the second report of the directors of the New York and Erie railroad, dated February 1st, 1841, and are there stated to be predicated on the *shortest route;*

and the distance from Elmira to Philadelphia has been ascertained with great accuracy since the completion of the survey for the northern route of the Harrisburg and Pittsburg railroad.

I am not prepared, at this time, to enter into a comparison between these routes, as I am not in possession of sufficient information relative to the New York and Erie railroad, but it may be as well here to state, that, on the route from Elmira to New York, the gradients rise as high as sixty feet per mile, while on that between Elmira and Philadelphia, the maximum grade is confined to forty-five feet per mile.

The aggregate of ascents and descents on that portion of the New York and Erie railroad between Elmira and Piermont, on the Hudson river, (22 miles from New York,) is stated in the report before alluded to as being 3,820 feet.

The aggregate ascent and descent from Elmira to Philadelphia, via the Williamsport and Elmira railroad, the northern route of the Harrisburg and Pittsburg railroad from Williamsport, and the Harrisburg and Philadelphia railroads, has been ascertained to be   feet.

SECOND REPORT ON THE SURVEY FOR A MACADAMIZED ROAD BETWEEN CHAMBERSBURG AND LAUGHLINSTOWN.

The plan of an artificial highway, or well constructed turnpike, with easy grades, extending through the broken and mountainous regions of the counties of Bedford and Somerset, for the purpose of connecting the Cumberland valley railroad with the contemplated railroad from Laughlinstown to Pittsburg, and thus forming a continuous communication from Philadelphia to Pittsburg, has been recommended for several years by those who advocate the interests of the southern tier of counties in Pennsylvania.

The combined nature of such a system of improvements, it has been alleged by its advocates, would allow of a very important saving of distance, if that part of the route which presents the greatest difficulties to the establishment of easy grades and direct courses, viz.: from Loudon to Laughlinstown, should be traversed by a turnpike.

As the employment of horse power on a turnpike for the transportation of goods may, under some circumstances, be found cheaper than the use of steam power, it was thought that the little expense with which goods could be transported over such a turnpike, added to the small tax which the cost and maintenance of such a road would impose upon the conveyance, would enable the improvement to compete successfully with rival lines. How far these views are correct, it is not for me here to decide; indeed it would appear premature to offer at this time a comparison between continuous lines of railroads which are now in course of construction, or in contemplation, and the improvement before us. It is true that the wagoning which is now carried on upon the southern turnpike, especially during the winter season, when the Pennsylvania canals are closed, will, as soon as the Baltimore and Ohio railroad is extended to Pittsburg, and a continuous communication by railroad established between Philadelphia and Pittsburg, entirely cease with respect to the transportation of goods from the Atlantic to the Ohio, and vice versa. But we should remember that the Cumberland valley railroad is in existance, and will be connected with the Baltimore and Ohio railroad—that this improvement extends through a very rich agricultural district; we should also consider that the growing population of the southern tier of counties will not only *require*, but be able in time to *support* a good turnpike themselves, and that the comparatively little cost of such an improvement will not require a very large business to sustain it, and we will come to the conclusion that this project should be treated differently from the manner in which rail-

roads generally are, and that, at least at present, it cannot be brought into a fair comparison with the other great thoroughfares from the east to the west.

The completion of the Baltimore and Ohio railroad is not very far distant, and the eventual formation of a continuous line of railway from Philadelphia to Pittsburg, by the shortest and best route, is equally certain. After these two lines have been in operation some time, and the Cumberland valley railroad has been extended to the Baltimore and Ohio railroad, we will be enabled to form a just estimate of the prospects of a combined improvement, which is to extend from Chambersburg to Pittsburg, nearly midway between the Baltimore and Ohio railroad on one side, and the Philadelphia and Pittsburg railroad on the other.

Actual surveys have rendered the idea of constructing a railroad through the counties of Bedford and Somerset, in the direction from the east to the west, to say the least, very problematical. The formation of the country appears to forbid such an attempt. The Laurel hill, Allegheny mountain, Ray's hill, Sideling hill, Scrub mountain, Scrub ridge and Cove mountain, form barriers, stretching parallel to each other directly across the course of the line, which appear effectually to prevent the attainment of short and straight distances, and the reduction of the gradients, upon which features the success of a railroad mainly depends. It was therefore but justice, while extensive surveys for a continuous railroad from Harrisburg to Pittsburg were being made, to authorize the survey for an improvement through the southern tier of counties which appeared to be best adapted to the character of that country, and would therefore promise a fair result. This survey has been made, and the distance from Laughlinstown to Loudon, by the line actually surveyed, was found to be ninety-nine miles, which may, by some alterations, and substituting the maximum grade in some places for a level grade, be reduced to ninety-eight miles. The distance by the present turnpike is eighty-seven miles, or eleven miles less. This may appear to some a great increase of distance, and there are many persons who entertain the opinion that a road, with no inclination greater than two and a half degrees, could be located with the same distance as the old turnpike. I am, however, convinced that the line established by the surveys of my principal assistant, Mr. Roebling, (with the exception of some minor alterations,) will be found, by future surveys, to be the best the nature of the ground will admit. Between the mountains we have invariably saved distance, but, in crossing them, we had of course to allow that distance which was necessary to overcome their elevations with grades not exceeding two and a half degrees. If a road should ever be made by the located line, its gentle gradients, (compared with the steep grades of the present turnpike,) would enable stage coaches to traverse the whole distance of Loudon to Laughlinstown, in thirteen hours, with less labor than it is now accomplished within the usual time of twenty-four hours. The greatest difference, however, would be experienced in the transportation of heavy goods. The best six horse teams are capable of hauling, on the present turnpike, when it is in good order, but from sixty to seventy-five cwt., the last being rather an extreme load. When the gradients are reduced to two and a half degrees, and the road kept always in a good state of repair, the same teams may then haul a load of six tons. One ton is the least allowance for one horse on well graded turnpikes in Europe, and the expense of hauling could not be cleared by taking less. It may be proper here to mention the charge of transportation on turnpikes. During the past season, many wagon loads of goods have actually been transported from Baltimore to Pittsburg for the trifling sum of from 75 cts., to $1 25 per cwt. The latter price is considered a fair compensation. One six

horse load was contracted for, to be taken from Baltimore to Zanesville, in Ohio, for $1 75 per cwt., and the wagoner appeared to be satisfied with his price.

No survey was made from Loudon to Chambersburg, as the site for a new and well located road would vary but little from the present turnpike.

Annexed to this report (54) will be found a table exhibiting the results of the estimates of cost for each mile of road, together with the average prices, amount of excavation, length of bridges, etc,

The dimensions of the road and the slopes of the banks, upon which the estimates have been based, vary with the nature of the ground. Where the ground is level, or not much sideling, the whole width of the road bed between the ditches is assumed at thirty-four feet—the side ditches on such locations to be six feet wide on top, and two feet deep. The metalling or stoneway, will be eighteen feet wide, leaving an earth or summer way of eight feet wide on each side, between the stone way and the ditches.

In deep cutting, the width of the road bed between the ditches is reduced to twenty-four feet, leaving a foot-path of three feet on each side of the stone way. The latter preserves its width of eighteen feet throughout. The ditches are in this case assumed as four feet wide on top.

High embankments occur but seldom, and will have a width of twenty-six feet on top, leaving a foot-path four feet wide on each side of the stone way. The slopes of the embankments to be one and a half feet to one in common earth, and one to one in harder material.

Where the sideling ground is steep, (as in the mountains,) the width of the road, including the ditch on the side hill, will be thirty feet. The stone way still continuing eighteen feet in width, and leaving a foot-path of five feet on the side of the valley, and one of three feet on the hill side, bordered by a ditch four feet wide. The slopes to vary from one and a half to one, to one to one.

The following plan for constructing the stone way, is that upon which the estimates have been made out.

A bed for the reception of the foundation is first excavated eighteen feet in width, by a curved pattern, so that the centre be six inches higher than the ends. Along the two sides of this bed small ditches are cut, from three to six inches wide, and from three to six inches deep. The material of the whole of this excavation is used to raise the summer ways on each side, so that they will slope off from the metalling to the ditches. The small ditches serve for the reception of two rows of curb stones, set upright, so that they project ten inches above the bed. Sound, flat stones are to be selected for this purpose. The curb stones form the sides of the foundation, and prevent it from spreading out; they are essential to the preservation of a good road.

The first layer of stones is regularly and closely packed, in the form of a pavement. The stones are always set upright, and when of a flat form they are set lengthwise across the road. At the same time the broadest end is used as the base, and the rougher and more pointed the tops of the stones are, the better, so that they may the better receive the next layer of broken stone. The thickness of this foundation is to be from five to six inches at the sides, and from six to seven inches in the middle. All kinds of hard stone, as limestone, freestone and graywacke, may be used for the packing.

The second course is to consist of a layer of broken stone, five inches deep at the sides and seven inches deep in the middle. The material may be of the same nature as the packing, but it must be broken so that each stone will pass through a four inch ring. The first portion of this course when spread

over the foundation, must be well rammed into the lower course, by which process the surface of the packing will become consolidated and even.

After the second course has been laid on, and rounded off by a pattern, the third and last course is to be put on, from four to five inches thick at the sides, and from five to six inches thick in the middle. This course will cover the curb stones, and be confined by the summer road or foot ways. The lower part of the top course may consist of broken stone which will pass through a two inch ring; the covering however should not contain stone larger than one and a half inches.

No other material to be used for the third course than limestone or kieselshieffer.* Wherever the latter material can be had within a distance of two miles, it should be prefered to limestone.

The surface of the stone way when finished, will form a curve of nine inches rise in the middle, and slope off on each side. These slopes are continued over the summer ways to the ditches. The whole thickness of the metalling by the above plan will be eighteen inches in the middle, and fifteen inches on the sides. The sectional area will be twenty-five square feet, therefore the cubic content is twenty-five cubic feet, or one perch per lineal foot, or five thousand two hundred and eighty perches per mile.

The cost of metalling and finishing the road as above described, is estimated at $5,800 per mile,† and by allowing this sum, a road may be obtained as good as any in existence, in this country or in Europe. Such a road will be capable of supporting the heaviest traffic, and by adopting a judicious system of constant repair can be kept in the best order at a very moderate yearly expenditure.

The plan for the formation of the stone way here proposed has been extensively used, and with the most perfect success, by the most distinguished European engineers. The main features are the same which were adopted by Messrs. Telford, M'Neill and Wingrove during their extensive practice, and recommended by Sir Henry Parnell, after an experience of twenty years as an active and efficient parliamentary commissioner of roads, in his excellent treatise on this subject, published in 1838. The French engineers have always favored this plan; and several thousands of miles of roads have been constructed upon this principle in Prussia, where its merits have been satisfactorily tested, and where road making is well understood.

It was only owing to the bold and imposing assertions and plausible arguments of Macadam, that the system called after his name, became, to a certain extent, popular, in spite of common sense, and partially superceded the plan established by experience and reason. Macadam's system has everything against it, and nothing to recommend it, and cannot be supported by an experienced and judicious engineer. The parliamentary investigations (pursued with so much patience and sagacity,) instituted for the purpose of

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* This material was found by Mr. Roebling in the course of the survey, west of Tussey's mountain, in great abundance, lying in vertical veins embedded between limestone rock. It is a species of flint, and is considered as the very best material for the upper layar of a stone way. It is almost a pure silex, thefore not liable to produce dirt upon the road, and at the same time it is easily broken. When fractured, its particles, owing to the roughness of their edges, will not give way, but unite into a solid mass. The properties of this valuable material appear not to be understood by those who have the management of the present road; the coarsely broken limestone, is, under the present system of repairs, preferred, because a road which is never well attended to, and always full of ruts, is more easily and quickly repaired when once reduced to its worst state by throwing on masses of course material which will not yield to the action of the wheels. A road having the upper surface covered with kieselshieffer, requires a little attention constantly, but can with very little care be kept in a high state of preservation, and perfectly smooth at all times. The most valuable material next to kieselshieffer is limestone.

† "Although the expense of constructing a road on this plan may seem to be great, on an average of five years, the joint expense of constructing and repairing such a road will be less than that of constructing and repairing a road made by putting the surface materials on the natural soil, without a paved foundation; for, in point of fact, such a road has usually to be nearly new made every year for some years after it is first opened."—Sir Henry Parnell, on Roads.

ascertaining the most approved form of road making, have drawn from the most skilful and experienced engineers and road surveyors, their opinions relative to the plan pursued by Macadam, and that carried to such perfection by Telford.

After a careful perusal of these investigations, together with the valuable works which have been written upon this subject—and after an attentive observation of the effect of travel, time and wet weather, upon the Macadamized roads in this country—but one opinion can be formed of Macadamization and Telfordization; (the word is used by Dr. Lardner in the course of his examination before the committee of the House of Commons,) the preference must be given to the latter system of road making.

The total cost of grading and bridging from the terminus of the railroad line at the western end of Laughlinstown to Loudon. 99$\frac{24}{100}$ miles, is	$506,425 21
Add to this the cost of metalling on the plan proposed, at $5,-800 per mile,	575,592 00
	$1,082,017 21

Or $10,903 04 per mile.

If a depth of stone of twelve inches, (instead of eighteen inches,) should be determined upon, the cost would be reduced to $4,000 per mile, so that a road can be made between Chambersburg and Laughlinstown with a stone way far better adapted for rapid travel and heavy wagons than any we have in the State, for $803,385 52. Twelve inches of metalling is more than is usually placed upon turnpike roads, but is equal, when laid on by the plan I propose, to twenty inches placed on in the common way, from the great solidity which the road acquires from the strength of the foundation, and the method of its construction.

Appendix, exhibiting the principles upon which the comparisons between the different routes are predicated, together with the comparisons and their results:

1. REDUCTION OF GRADIENTS TO A LEVEL AND STRAIGHT LINE.

In order to be enabled to enter into the calculations required for ascertaining the cost of transportation and management of a railroad, it becomes first necessary to reduce the gradients and curvature to a level and straight line. The extent of a straight level thus allowed for the gradients and curvature, added to the actually measured distance, will give the *virtual* distance of the line.

The amount of steam power necessary to convey a load over a succession of ascents, is equivalent to the power required for lifting the same load through a perpendicular height equal to the aggregate ascents of the inclines, plus the power to be consumed for conveying the same load over a level distance of the same extent. Now, it is generally admitted that the amount of power which is necessary to raise a load through a perpendicular height of twenty-one feet, is equivalent to what is required for the conveyance of the same load over one mile of level and straight road in the same time. To reduce, therefore, the ascents to a level, we should divide the aggregate rise by twenty-one, and the quotient will express the number of miles to be added to the measured distance. But as the ascents differ in the two directions materially, we should perform the reduction both ways.

When a train descends a plane, the inclination of which is equal to the angle of repose, it is evident that no power from the engine will be required to propel the load; its own gravity will be sufficient to overcome the resistance arising from friction. Now as the engine in so descending exerts no power of traction, it is clear that the additional friction of the engine itself, which

on a level or on an ascent results from this traction, and which amounts to about one pound per ton of load, ceases to exist. We have only to consider the resistance due to the friction arising from the weight of the load, which is established at from eight to nine pounds per ton, and the resistance resulting from the motion of the engine itself, and which amounts to about one hundred and fifty pounds for an engine of ten tons weight.

By dividing 2240 by 9, we obtain $\frac{1}{249}$ one foot rise in a distance of two hundred and forty-nine feet, as the inclination corresponding to the angle of repose for the load, and which is equal to 21·20 feet per mile. The inclination of repose for an engine of ten tons weight, the friction of which amounts to one hundred and fifty pounds, is equal to $\frac{150}{2240}$ or $\frac{1}{149}$, equal to 35·43 feet per mile, which is considerably more than the angle of repose for the load. From this it appears we cannot fix the angle of repose for a descending train, without determining the whole weight of the train.

Suppose the average gross weight of the train itself to be 250 tons, and that of the engine 10 tons. The resistance of the train due to friction is therefore $250 \times 9 =$ 2,250 lbs.

Add the resistance owing to the friction of the engine,	150	"
And we have a total resistance of the train,	2,400	lbs.

The aggregate weight of the train and engine in pounds is $206 \times 2,240 = 582,400$ pounds. This divided by the total resistance, gives us $582,400 \div 2,400 = \frac{1}{242 \cdot 66}$ as the rate of inclination which corresponds to the angle of repose for the whole train, and dividing one mile 5,280 feet by 242·66, we obtain 21·76 as the descent per mile equivalent to the angle of repose.

In practice, however, a greater expenditure of steam power will take place, than is required by the above calculation. Where the grades are undulating, the steam power has to be kept up on descent in order to obtain a sufficient accumulation of power to overcome the following ascents. And on long descents, say of 45 feet per mile, safety requires a ready store of power to be applied for reversing the motion of the engine in case of accidents. Some loss of fuel will therefore be incurred from these causes.

No experiments have yet been made by which we can determine the precise amount of steam power required on descending planes, to overcome the resistance of friction and the atmosphere.

On inclinations of less than thirty feet per mile, and on short undulating gradients, from a level to forty-five feet per mile, we may assume the saving of power resulting from a descent of thirty-five feet, as equivalent to the power required on one mile of a straight level. No power will therefore be needed on a descent of 35 feet per mile, or planes exceeding this inclination, provided such descents are of no great extent, and are followed either by ascents, levels, or descents under thirty feet per mile. This principle, however, will not apply to long planes descending more than thirty-five feet per mile. On such descents an actual gain of power, resulting from accelerated velocity, would take place, according to the above supposition. But as it is dangerous to increase the speed beyond certain limits, or to make use of the accelerating force of gravity to its full extent on steep inclines, nothing will be gained from any excess of gravity, but what is wanted to overcome the friction of the train.

In such cases, as for instance on the eastern descent of the Allegheny mountain, from the west to the east, we should allow, say fifty feet of descent, as equivalent to one mile of level in point of expense of steam power. Or the amount of steam power required on one mile of road, descending forty-five feet, is equivalent to the power expended upon a straight and level road of $\frac{50-45}{50}$ or $\frac{1}{10}$ of a mile in length.

2. REDUCTION OF CURVATURE.

To exhibit the effect which the curvature of the road will have upon the locomotive power, we will adopt, as a basis for our calculations, the result of experiments which were made for that purpose by the engineers of the Baltimore and Ohio railroad.

The resistance arising from a curvature equivalent to three hundred and sixty degrees of deflection, was found to be equal to the amount of resistance of a straight and level line of 0·238 miles. The mechanical resistance arising from the curvature of a line, will, therefore, be equivalent to the resistance of a level and straight line, the extent of which is obtained by dividing the aggregate sum of degrees of deflection by 360, and multiplying the quotient by 0·238.

FUEL.

The quantity and cost of fuel for transportation at different speeds has been ascertained and nearly reduced to a certain standard on different roads in this country and in England. From these facts, we have, with a due regard to circumstances, allowed one-fifth of a cent as the average cost of fuel for the conveyance of one ton gross weight of passenger trains, over one mile of level and straight road, at a velocity of twenty miles per hour; and one-tenth of a cent as cost of fuel for one ton of freight train, over one mile of level and straight road, at a velocity of ten miles per hour.

COST OF MACHINERY AND WEAR AND TEAR.

The wear and tear of the machinery will be nearly in proportion to the work performed. Now, as its capacity will be nearly regulated to the grades, the wear and tear may be estimated in proportion to the actual running distance, including the equation for the curvature of the road.

The annual expense of wear and tear, and depreciation of a locomotive engine and tender for passenger trains, will be assumed at	$2,500
And the engine and tender for freight trains, at	2,000
Of a passenger car, including oil,	500
Freight, " "	145

REPAIRS AND SUPERVISION OF ROAD.

The annual repairs of the graduation, culverts, and double railway track, including the supervision of the road, is estimated at $800 per mile. The annual repair of the wood-work of viaducts is estimated at 4 per cent. on the first cost.

TO PHILADELPHIA.

No. 1.	Projected railroad from Cleveland to Pittsburg,	130·00	miles.
	Harrisburg and Pittsburg railroad, (middle route,)	229·57	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Cleveland to Philadelphia,	466·32	miles
	Maximum gradient, 45 feet per mile.		

TO BALTIMORE.

No. 2.	Projected railroad from Cleveland to Pittsburg,	130	miles.
	Baltimore and Ohio railroad,	337	"
	Total distance from Cleveland to Baltimore,	467	miles.
	Maximum gradients, 84 and 66 feet per mile.		

TO NEW YORK.

No. 3.	From Cleveland to Philadelphia as by route No. 1,	466·32	miles.
	From Philadelphia to New York by railroad,	85	"
	Total distance from Cleveland to New York,	551·32	miles.
	Maximum gradient, 45 feet per mile.		

TO PHILADELPHIA VIA ERIE.

No. 4.	By lake, from Cleveland to Erie,	120·00	miles.
	By Sunbury and Erie railroad,	286·56	"
	By Sunbury and Catawissa, Little Schuylkill and Susquehanna, Little Schuylkill and the Reading railroads,	148·44	"
	Total distance from Cleveland to Philadelphia,	555·00	miles.
	Maximum gradient, 66 feet per mile.		

TO NEW YORK VIA DUNKIRK.

No. 5.	By lake from Cleveland to Dunkirk,	170	miles.
	By New York and Erie railroad,	448	"
	By Hudson river, from Piermont to New York,	22	"
	Total distance from Cleveland to New York,	640	miles.
	Maximum gradient, 60 feet per mile.		

TO BOSTON VIA BUFFALO.

No. 6.	By lake from Cleveland to Buffalo,	210	miles.
	By Batavia and Buffalo railroad,	36	"
	By Rochester and Batavia "	33	"
	By Auburn an Rochester "	78	"
	By Syracuse and Auburn "	26	"
	By Utica and Syracuse "	53	"
	By Utica and Schenectady "	78	"
	By Mohawk and Hudson " (to Albany,)	16	"
	By Western "	157	"
	By Boston and Worcester "	44	"
	Total distance from Cleveland to Boston,	731	miles.
	Maximum gradient, 80 feet per mile.		

TO NEW YORK VIA BUFFALO.

No. 7.	By lake to Buffalo,	210·00	miles.
	By railroads from Buffalo to Albany, as by route No. 6 and by the New York and Albany railroad,	467·71	"
	Total distance from Cleveland to New York,	677·71	miles.
	Maximum gradient, 60 feet per mile.		

TO PHILADELPHIA.

No. 8.	Total distance by railroads as by route No. 4,	435	miles.
	Maximum gradient, 66 feet per mile.		

TO PHILADELPHIA.

No. 9.	Projected railroad via Meadville, Allegheny river, Kiskiminetas and Conemaugh, to the middle route,	171·00	miles.
	Middle route, from the point of intersection, to Harrisburg,	187·25	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Erie to Philadelphia,	465·00	miles.
	Maximum gradient, $52\frac{80}{100}$ feet per mile.		

TO NEW YORK VIA DUNKIRK.

No. 10.	By lake to Dunkirk,	50	miles.
	From Dunkirk by New York and Erie railroad, and by Hudson river, as by route No. 5,	470	"
	Total distance from Erie to New York,	520	miles.
	Maximum gradient, 60 feet per mile.		

TO NEW YORK VIA BUFFALO.

No. 11.	By lake to Buffalo,	90·00	miles.
	Railroads as by route 7,	467·71	"
	Total distance from Erie to New York,	557·71	"
	Maximum gradient, 60 feet per mile.		

TO BOSTON VIA BUFFALO.

No. 12.	By lake to Buffalo,	90	miles.
	Railroads as by route 7,	521	"
	Total distance from Buffalo to Boston,	611	miles.
	Maximum gradient, 80 feet per mile.		

TO NEW YORK—BY RAILROAD AND RIVER.

No. 13.	New York and Erie railroad,	448	miles.
	Hudson river from Piermont to New York,	22	"
	Total distance from Dunkirk to New York,	470	miles.
	Max. gra. 60 ft. pr mile, from Elmira to N. York.		

TO PHILADELPHIA—BY RAILROAD.

No. 14.	New York and Erie railroad to Elmira,	194·00	miles.
	Williamsport and Elmira railroad,	74·00	"
	Northern route of the Harrisburg and Pittsburg railroad, as located from Williamsport to Harrisburg,	91·50	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Dunkirk to Philadelphia,	466·25	miles.
	Max. gra., 45 ft. pr mile, from Elmira to Phila.		
No. 15.	Total distance from Buffalo to New York by the railroads to Albany, as by route 7, and the New York and Albany railroad,	467·71	miles.
	Maximum gradient, 60 feet per mile.		
No. 16.	Total distance from Buffalo to Boston, as by railroads in route 6,	521	miles.

TO NEW YORK.

No. 17.	From Buffaly, by the grand Erie canal and the Hudson river,	508	miles.

TO PHILADELPHIA FROM ERIE.

No. 18.	Erie extension of the Pennsylvania canal,	104·50	miles.
	Beaver division, " " "	30·75	"
	Ohio river to Pittsburg,	26·00	"
	Western division of the Pennsylvania canal,	104·00	"
	Portage railroad, " " "	36·00	"
	Juniata division, " " "	127·50	"
	Eastern, " " "	44·50	"
	Philadelphia and Columbia railroad,	82·00	"
	Total distance from Erie to Philadelphia by State improvements,	556·25	miles.

TO PHILADELPHIA FROM CLEVELAND.

No. 19.	Ohio canal from Cleveland to Akron,	38	miles.
	Pennsylvania and Ohio canal to Beaver division,	84	"
	From point of junction of P. and O. canal, by Beaver division, to the town of Beaver on the Ohio river,	22	"
	Ohio river to Pittsburg,	26	"
	Western division, Portage railroad, Juniata division, Eeastern division and Columbia railroad,	394	"
	Total distance from Cleveland to Philadelphia,	564	miles.

RAILWAY TRAFFIC IN ENGLAND.

We give the annexed extract from the London Railway Magazine, of 29th April, to show the immense amount of travel in Great Britain, by railways. *Twenty millions* of passengers carried on railways, besides all other modes of conveyance, and at a cost of £4,000,000 a year. It will be hardly credited here—though probably within the truth.

"The following calculation of the last weekly returns of 44 railways, 1,560 miles in length, given in our present number, will, we believe, be of interest: number of passengers on 28 railways, 327,142, consequently the total for the week must be about 500,000. The receipts for passengers on 44 railways, £68,832 17s. 3d.; ditto for goods on 39 railways, £22,526 10s. 11d.; total, £91,359 8s. 2d. This is an average of £58½ per mile per week. The traffic, therefore, is certainly at the rate of about four millions and a half a year, and carrying twenty millions of passengers.

NAME.	Passengers per week.	Total receipts.	Total 1842.
Brimingham and Derby,		£1337	£1062
Birmingham and Gloucester,		1759	1508
Brandling Junction,	11,562	795	745
Chester and Birken,	3,839	495	455
Dublin and Kingstown,	32,178	764	874
Durham and Sunderland,	2,864	599	
Edinburgh and Glasgow,	10,039	2014	2072
Eastern Counties,	20,183	2304	891
Glasgow and Ayr,	15,107	1070	956
Glasgow and Greenock,	16,129	687	658
Grand Junction and Ch. and Cr.,		6956	8636
Great North of England,		1407	1304
Great Western,	33,625	13723	12951
Hull and Selby,	4,173	1,085	960
Liverpool and Manchester,		3795	3833
London and Birmingham,		15859	16313
London and Blackwall,	42,131	682	848
London and Brighton,	11,820	3435	2232
London and Croydon,	4,627	308	443
London and Greenwich,	24,610	773	830
London and South Western,		6169	6041
Manchester, Bolton, and Bury,		672	573
Manchester and Birmingham,		3037	352
Manchester and Leeds,		4742	4228
Midland Counties,	10,264	2544	2424
Newcastle and Carlisle,		1264	1345
Newcastle and North Shields,	16,556	360	312
Northern and Eastern,	12,480	1615	1345
North Midland,		4133	3988
North Union,	2,387	985	931
Preston and Wyre,	1,108½	179	137
Sheffield and Manchester,	20,691	522	282
South Eastern,	7,219	2052	
Ulster,	9,046	597	439
York and North Midland,	7,410	1596	1568

The entire length of these 44 railroads is only 1560 miles, whereas we

shall have within 15 years, a line of road, under a uniform system of management, of a thousand miles in length.

CANAL BETWIXT CAIRO AND SUEZ.

We learn, on the authority of a correspondent at Cairo, that the Pasha has determined on constructing a canal between that city and Suez, and that the work is to be commenced forthwith. It is expected that this undertaking will not prove so arduous as at first sight may appear; in many places all that is requisite to be done being merely to clear out the bed of the ancient canal; and as Mehemet Ali has now turned his sword into a ploughshare, it is not improbable he may find employment for some of his troops on the work. The following particulars of this ancient canal may not be uninteresting to our readers:

The great Sesostris appears to have been the first who conceived the project of uniting the Nile to the Red Sea by means of a canal, and actually commenced this gigantic enterprise, which, however, he did not finish. At a subsequent period it was resumed by one of his successors, Pharaoh Necho, on which occasion 120,000 men perished. It was not, however, then completed, in consequence of the response of the oracle, which was consulted by that monarch, to the effect that "the construction of the proposed canal would expose Egypt to the invasion of foreigners." During the dominion of the Persians, however, it was continued by Darius, the son of Hystas pes, and finally completed by Ptolemy Philadelphus, after whom it was named. The geographer Strabo relates that it "was furnished with ingeniously contrived sluices, which were opened to admit the passage of vessels, and afterwards very promptly shut." It was 140 miles long, 60 yards wide, and 30 feet deep. It commenced at the Pelusiac, or most easterly branch of the Nile, near Bubasatis, (about 35 miles north of Cairo,) and after flowing through the lake Amer, like the Rhone through the lake of Geneva, it terminated at Assinie, a town near the site of the modern Suez, By means of this canal, vessels from the Red sea, when they reach the Pelusiac branch of the Nile, could either descend to the Egyptian ports of the Mediterranean, or ascend the river to Memphis and Thebes. By furnishing an abundant supply of water for irrigation, it fertilized the desert on both sides of its banks, which were soon covered with opulent cities, among which may be mentioned Phagroniopolis, Heroopolis and Serapeum, the positions of which are indicated in our chart.

During the Roman dominion in Egypt, this canal was renewed or repaired by the Emperor Trajan, who added a branch to it, which communicated with the Nile near old Cairo. This prolongation of the canal bore the name of the Emperor, as is explicitly stated in the following passage: "Between Heliopolis and Babylon, (old Cairo) flows the river Trajan."

Our correspondent does not inform us whether it is in contemplation to renew the whole of these canals, or what deviation is contemplated in consequence of the Pelusiac branch of the Nile being now dried up, except that the point of junction with the Nile is to be at Shubra, in order that the city of Cairo may derive benefit from the undertaking.

We may add that, although our correspondent was assured on very good authority that the work is to be commenced immediately, he is rather skeptical as to the means possessed by the Pasha of carrying it into immediate execution.

Safe Travelling.—The Newburyport Herald says, that "On the 17th of June, ten thousand passengers were transported without the slightest ac-

cident, over the whole line of 100 miles of the Eastern railroad, by day and night. Eighteen regular trains beside some extras were run on the road, commencing at 4 o'clock in the morning and continuing until after midnight.

The following article, well worth the attention of engineers and others interested in the improvement of the locomotive, was sent to us several months ago, but by accident was not received. It has since been published in another journal, but as we are desirous of placing it upon our pages, we have thought proper to make this explaination.

LETTER FROM CHARLES MOERING, ESQ., ENGINEER, TO MESSRS. EASTWICK & HARRISON, LOCOMOTIVE BUILDERS CORNER OF TWELFTH AND WILLOW STS., PHILADELPHIA.

Gentlemen—In complying with your request to give you my opinion about your locomotive engines, I feel called upon to state the grounds that make this opinion what it is.

I do this in view of the interests of science, not intending to pass a mere encomium upon the productions of your establishment. Every engineer is, no doubt, conversant with the fact, that the power of a locomotive engine not only depends on the harmonious proportions of boiler and cylinders, and on the clever mechanical arrangement to work the pistons and transfer motion to the driving wheels; but every engineer must be also aware of the importance of another fact, viz: *the manner in which this power is made available in order to draw a maximum load, at a maximum speed, on a railroad.*

In examining this point, we find that a fulcrum is required to enable the steam power to act upon the weight, or the load to be drawn. This fulcrum in the locomotive engine, is evidently the grip of the driving wheels on the rails, meaning the friction between both, or *adhesion*, as it is technically called. Let a locomotive engine be ever so powerful, but take away the aforesaid friction, and the wheels will slip, the engine will draw nothing. This adhesion, derived from the pressure of the weight of the engine, must, therefore, bear a certain proportion to the latter. Its maximum will be obtained by throwing the largest, its minimum by placing the smallest amount of the engine's weight on the driving wheels. The minimum, however, has at no time been a desideratum, as the largest amount of adhesion is required for enabling an engine of a given power to draw a maximum load at a maximum speed.

In the six wheeled American engine, the true offspring of American mechanical talent, as possessing a fore truck, which affords a most opportune facility for turning curves, there is but *one* axle to bear the aforesaid proportion of weight; and this axle is the driving axle. On its position, therefore, depended the amount of weight to be made available for producing friction. As it was found impossible, as well as improper in practice, to place this *single* driving axle under the centre of gravity, for the purpose of equilibrating the entire weight of the engine, there remained but two other positions, viz: *behind and close before the fire box.*

To illustrate the effect in both cases, let us suppose two engines, A and B, each of 12 tons weight in running order, with cylinders, boilers and driving wheels of the same dimensions, and performing the same amount of duty on two roads of exactly the same kind.

In the engine A, with the driving axle *behind* the fire box, it was found that only *half* of its weight was brought into action for the purpose of pro-

ducing friction, amounting in this case to $\frac{12}{2}=6$ tons.

In the engine B, with the driving axle *before* the fire box, *two-thirds* were found available for the same purpose, equal to $\frac{2\times12}{3}=8$ tons. The ratio of *adhesion* is, therefore, A : B=6 : 8, meaning that the engine B possesses a surplus of two tons in its adhesive power, *and, consequently, in its capability of drawing loads.*

In further examining our subject, another question arises, concerning the effect of the given ratio of adhesion on the rails. In the engine A we have, as mentioned, six tons on the driving axle, and, therefore, three tons on each driving wheel. In the engine B, however, we find eight tons on the driving axle, and, consequently, four tons on each driving wheel. The proportion of *weight* on the rails is, accordingly, A : B=3 : 4.

Supposing these two engines to run at the same speed, S, and assuming the stress by impact upon the rails to be represented approximately by the speed multiplied into the weight imposed upon each driving wheel, then each line of rails would be percussed by A, with $S\times3=3S$, and by B, with $S\times4=4S$.

This gives a ratio of *impact* A : B=3S : 4S or A : B=3 : 4; meaning, for the sake of practical illustration, that the engine B will ruin the rails, take them to be thirty-eight pounds per yard, after the lapse say of nine years; while the engine A will produce the same deterioration only after the space of twelve years, supposing the amount of traffic and other conditions to be the same in both cases.

Although no actual observations of this nature have been made with regard to the rails, yet the average duration of the wrought iron tires on the driving wheels, proves the above proportion not to be an incorrect one. The duration of tires on engines, with the driving axle *behind* the fire box, has been found to exceed the duration of those on engines with the driving axle *before* the fire box; and taking the latter to be nine months at an average, the duration of the first has been found to amount to from twelve to fourteen months.

Wronght iron rails being manufactured in the same way as tires, it can be but a fair assumption, that the duration of rails will admit of the same proximate scale given in the above proportion of impact.

This brief exposition, backed by the ratio of *tractive power*, A : B=6 : 8, and by the proportion of *duration*, A : B=3 : 4, makes it obvious why the *diminution of impact* in the engine B, possessing a superior power of traction, was found of such great importance, and has thus constantly occupied the attention of the American machinists and engineers. In pursuance of this notion, the eight wheeled engine was started with *two* driving axles, one *before* and the other *behind* the fire box.

Supposing such an engine C, to weigh twelve tons, in running order, and of the same dimensions as A and B, the weight on the two driving axles was found to be also *two-thirds*, or eight tons, yet pressing upon the road, on the four points of contact, only with $\frac{8}{4}=2$ tons.

The proportion of *adhesion*, or *tractive power*, is, therefore, A : C=6 : 8, B : C=8 : 8, A : B : C=6 : 8 : 8.

The ratio of *impact*, or *deterioration of the rails*, being C : A=2 : 3, C : B=2 : 4, C : A : B=2 : 3 : 4.

From this we may infer that rails lasting but nine years under the performance of the engine B, and twelve when traveled upon by the engine A, will not meet with their ulterior destruction before eighteen years, when engines of the kind C, are running upon them under the aforementioned suppositions.

I can, therefore, but applaud your resolution of building systematically no other engines but those with eight wheels—four driving and four truck wheels. However, I feel myself called upon to impress you with the advantages that must necessarily result when the number of driving wheels can be augmented to six or eight, without loosing that beautiful characteristic of the American engine, viz: *the free vibrating truck*, which in its office of piloting the engine along the track, I think invaluable for the American railroads, with their sharp turns and light superstructure.

An engine, D, with *three*, and an engine, E, with *four* driving axles, lending an opportunity to make their *whole* weight available for adhesion, which then would be that due to the maximum weight of twelve tons, in the given case, would certainly possess the greatest tractive power, and yet injure the road in a much less degree. The proportions of adhesion, or tractive power, would be the following ones, supposing in every case that the engine possesses sufficient power to slip her wheels in pulling against a fixed point, A : B : C : D : E=6 : 8 : 8 : 12 : 12; and the proportions of impact, or deterioration of the rails, B : A : C : D : E=4 : 3 : 2 : 2 : 1½.

I am aware of all the difficulties attending what I propose, but I feel, nevertheless, confident that "flexible coupling rods," permitting all the axles, with the exception of the main driver, to conform to the radii of curves, are within the pale of practical feasibility. Only on this condition should I think myself justified in preferring engines with a greater number of driving axles than two, were I even inclined to overlook the greater complication that such a mechanical arrangement must require. I reckon simplicity to be one of the cardinal virtues in any mechanical apparatus, and of the most absolute necessity in the locomotive engine.

After this digression, permit me, gentlemen, to come back to the *eight wheeled engine*, C, as the subject of my disquisition. Great as the improvement promised to be, in introducing the aforesaid engine, the advantages derived thereform for the preservation of the rails, were, however, nearly lost. The difficulty consisted in the stiff connection of the fire box, boiler, smoke box, and pedestals of the driving wheels, with the frame, which acted like a lever. Whenever one pair of driving wheels was raised, by some irregular elevation in the track, resulting from its bad condition, the other pair, in consequence of the springs not acting quick enough to force them down, were momentarily lifted up by the frame, consequently without bearing their due proportion of weight; and, on the contrary, when one pair was passing over a depression in the road, the other again, for the same reason, had to sustain nearly the whole amount of weight originally allotted to both driving axles—the truck wheels always acting as a fulcrum, and the frame, with its fixed pedestals and the axles therein revolving, as the lever.

This could not help injuring the road nearly in the same degree as the engine B; nay, the effects were still more injurious to the engine C, itself, as in the case of the main driving axle being suspended by the frame, in one of the aforesaid elevation or depressions of the other driving axle, the former received its rotary motion from the pistons without its fulcrum or adhesion to the rails.

It is but just to say, gentlemen, that you saved the eight wheeled engine from becoming a mere notion, and that owing to your exertions, it has been

brought to such a state of perfection as ought to make the old six wheeler, of the kinds A and B, quite absolete. It is furthermore, but justice to state, that your special adaptation of the lever, or balancing beam, to the use of locomotives upon railways, obviated the aforesaid difficulties in such a manner as to leave but little to desire; and here I regret to say, that some of the northern railroads in Germany—notwithstanding the unqualified recommendation of so able an engineer as Mr. C. E. Detmold—have not adopted engines with your improvement.

I consider the balancing beam, supported in its centre by a vertical shaft, resting on springs that are attached by the pedestals to the frame, and stayed on its ends by two vertical pins abutting against the two driving axles, as possessing, in an eminent degree, the two indispensable qualities—*first*, of equalizing the weight on both driving axles, in whatever condition the road may be, and, therefore, producing in an eight wheel engine of twelve tons, a constant and equal adhesion of eight tons, yet pressing the rails with but two tons; and, *second*, of furthermore diminishing the very ratio of impact as given above, the weight of the engine being suspended in the middle of the lever beam, causing it to fall only half the depth of any of the driving axles, in their passage over any short or sudden depression in the track, while the engines A and B must go down the whole depth, as supported by one axle alone, which by increasing the height of fall, must add to the power of the percussion, and, therefore, ruin the road even in a shorter period than the proportionate number of twelve or nine years.

But this is not alone what distinguishes your engines, the balancing beam of your arrangement being now used by nearly all the engine builders of note in the United States, after having purchased the patent right from you, which at once bespeaks the great merit and usefulness of your improvement.

It is, besides, the very simplicity of your engines that must engage the attention of even the least observing. Instead of four eccentrics, four eccentric rods, four latches, and a complicated arrangement to put them in and out of gear, by an extra hand lever, thus making three hand levers altogether, you have but two eccentrics, two eccentric rods, no latches, and a simple arrangement of the reversing valve; the whole to be handled by one and the same lever, and this, too, by moving it in exact accordance with the required movement of the engine.

It is true that in reversing you lose in speed, as the lead of the slide no longer takes place; but this loss I think of no moment, as it only happens when the engine is backing. Besides, the position of your forcing pumps is such as to prevent the freezing of the water, an advantage of great importance with locomotion in northern climes.

Gentlemen, this is my canded opinion about your eight wheeled engines, and you are welcome to make any use of this document. Permit me to avail myself of this opportunity to thank you for your readiness, and the frank and open way in which you satisfied my desire for information; and allow me to assure you that the modest and unostentatious manner in which you spoke of your engines, trusting more to their own merits than to puffing and boisterous recommendations, has most favorably impressed me with your own personal character. I am, gentlemen, your's, respectfully,

Charles Moering,

Captain of Engineers in the Austrian Army.

Philadelphia, September 1st, 1842.

DESTRUCTION OF THE ROUND-DOWN-CLIFF BY GUN-POWDER.

You will not be surprised to hear that the announcement that an explosion

of 18,000 lbs. of powder was to be made in the Round Down Cliff this afternoon brought in an influx of stangers into this town; still, though considerable, it was not so large as I had expected. Curiosity was, I think, paralyzed by a vague fear of danger, which kept some thousands at home who might have witnessed it, as the event turned out, without the slightest shock to their nervous system. The experiment succeeded to admiration, and, as a specimen of engineering skill, confers the highest credit on Mr. Cubitt, who planned, and on his colleagues who assisted, in carrying it into execution.

Everybody has heard of the Shakspeare Cliff, and I have no doubt that a majority of your readers have seen it. I should feel it a superfluous task to speak of its vast height were not the next cliff to it, on the west, somewhat higher. That cliff is Round Down Cliff, the scene and subject of this day's operations. It rises to the height of 375 feet above high water mark, and was, till this afternoon, of a singularly bold and picturesque character. To understand the reasons why it was resolved to remove yesterday no inconsiderable portion of it from the rugged base on which it has defied the winds and waves of centuries, I must make your readers acquainted with the intended line of railway between Folkestone and this place.

At Folkestone there will be a viaduct of great height and length. Then there will be a tunnel, called from a martello tower near it, the Tower Tunnel, one third of a mile in length. Then comes a cutting through the chalk of two miles in length, called Warren's cutting. Then comes the Abbott's Cliff tunnel, one mile and a quarter in length, and now half finished, although only commenced on the 16th of August last. From the Abbott's Cliff tunnel to the Shakspeare Cliff tunnel the railroad will be under the cliffs close to the sea, and protected from it by a strong wall of concrete two miles long, and with a parapet of such a height as will not preclude passengers from the splendid marine view which lies under them. Now it was found that when a straight line was drawn from the eastern mouth of the Abbott's cliff tunnel to the western mouth of the Shakespeare tunnel, there was a projection on the Round Down cliff which must be removed in some way or other to insure a direct passage. That projection, seen from the sea, had the appearance of a convex arc of a circle of considerable diameter. It is now removed, and some idea of its size may be formed from the fact that a square yard of chalk weighs two tons, and that it was intended by this day's experiment to remove 1,000,000 tons. The Shakspeare tunnel is three-quarters of a mile long, and it is about the same distance from that tunnel to the town of Dover.

Having premised thus much as to the locality of Round Down cliff, I now proceed to describe, as briefly as I can, the means employed to detach from it such an immense mass of solid matter. A horizontal gallery extended for about 100 yards parallel with the intended line of railway, from which cross galleries were driven from the centre and extremes. At the end of these cross galleries shafts were sunk, and at the bottom of each shaft was formed a chamber, 11 feet long, 5 feet high, and 4 feet 6 inches wide. In the eastern chamber were deposited 5000 lbs. of gunpowder, in the western chamber 6000 lbs., and in the centre chamber 7000 lbs., making in the whole 18,000 lbs. The gunpowder was in bags, placed in boxes. Loose powder was sprinkled over the bags, of which the mouths were opened, and the bursting charges were in the centre of the main charges. The distance of the charges from the face of the cliff was 70 feet at the centre and about 55 feet at each end. It was calculated that the powder, before it could find a vent, *must* move 100,000 yards of chalk, or 200,000 tons. It was also confidently expected that it *would* move 1,000,000 tons.

The following preparations were made to ignite this enormous quantity of powder. At the back of the cliff a wooden shed was constructed, in which three electric batteries were erected. Each battery consisted of 18 Daniels' cylinders, and two common batteries of 20 plates each, to which were attached wires which communicated at the end of the charge by means of a very fine wire of platina, which the electric fluid as it passed over it, made red hot, to fire the powder. The wires covered with yarn were spread upon the grass at the top of the cliff, and then falling over it were carried to the eastern, the centre, and the western chamber. Lieutenant Hutchinson of the Royal engineers, had the command of the three batteries, and it was arranged that when he fired the centre, Mr. Hodges and Mr. Wright should simultuneously fire the eastern and western batteries, to ensure which they practised at them for several previous days. The wires were each 1,000 feet in length, and it was ascertained by experiment that the electric fluid will fire powder at a distance of 2,300 feet of wire. After the chambers were filled with powder, the galleries and passages were all *tamped* up with dry sand, as is usually the case in all blasting operations.

At 9 o'clock A. M., a red flag was hoisted directly over the spot selected for the explosion. The wires were then tested by the galvanometer, the batteries were charged, and every arrangement completed for firing them.

It was arranged that the explosion should take place at 2 o'clock; at that time there was an immense concourse of people assembled. In a marquee erected near the scene of operation, for the accommodation of the directors and distinguished visitants, we observed among the number assembled, Sir John Herschell, General Pasley, Colonel Rice Jones, Mr. Rice, M.P., Professors Sedgwick and Airy, the Rev. Dr. Cope, and there was also a strong muster of engineers, among whom were Mr. Tierney Clark, Mr. John Braithwaite, Mr. Charles May, Mr. Lewis Cubitt, and Mr. Fred. Braithwaite; the engineers and directors of the Greenwich, Croydon, Brighton, and South Eastern railways, besides numerous foreigners of eminence.

At 10 minutes past 2, Mr. Cubitt, the company's engineer in chief, ordered the signal flag at the western marquee to be hoisted, and that was followed by the hoisting of all the signal flags. A quarter of an hour soon passed in deep anxiety. A number of maroons, in what appeared to be a keg, was rolled over the cliff, and on its explosion with a loud report, all the flags were hauled down. Four more minutes passed away, and all the flags except that on the point to be blasted were again hoisted. The next minute was one of silent and breathless and impatient expectation. Not a word was uttered, except by one lady; who when too late, wished to be at a greater distance. *Galeatum sero duelli pœnitet.* Exactly at 26 minutes past 2 o'clock a slight twitch or shock of the ground was felt, and then a low, faint, indistinct, indescribable moaning subterranean rumble was heard, and immediately afterwards the bottom of the cliff began to belly out, and then almost simultateously about 500 feet in breadth, with reference to the railway's length of the summit began gradually to sink.

There was no roaring explosion, no bursting out of fire, no violent and crashing splitting of rocks, and what was considered extraordinary, no smoke whatever; for a proceeding of mighty and irrepressible force, it had little or nothing the appearance of force. The rock seemed as if it had exchanged its solid for a fluid nature, for it glided like a stream into the sea, which was at a distance of about 100 yards, perhaps more, from its base, tearing up the beach in its course, and forcing up and driving the muddy substratum together with some debris of a former fall, violently into the sea, and when the mass has finally reached its resting place a dark brown color was soon

on different parts of it, which had not been carried off the land; the shattered fragments of the cliff are said to occupy an area of 15 acres, but we should judge it to be much less. I forgot to minute the time occupied by the descent, but I calculate that it was about four or five minutes. The first exclamations which burst from every lip was, "Splendid, beautiful!" the next were isolated cheers, followed up by three times three general cheers from the spectators, and then by one cheer more. These were caught up by the groups on the surrounding downs, and, as I am informed, by the passengers in the steamboats. All were excited, all were delighted at the success of the experiment, and congratulation upon congratulation flowed in upon Mr. Cubitt for the magnificent manner in which he had carried his project into execution.

As a proof of the easy, graceful and swimming style with which Round Down Cliff, under the gentle force and irresistible influence of Plutus and Pluto combined, curtseyed down to meet the reluctant embraces of astonished Neptune, I need only mention that the flagstaff, which was standing on the summit of the cliff before the explosion took place, descended uninjured with the fallen debris.

No fossil remains of the slighest importance were brought to light, which was a matter of disappointment to many. A very few even of the most ordinary character were found among the mass, which it may well be imagined was soon after the explosion, teeming with the curious multitude from the cliffs above, anxious to obtain some relic of the event.

On examining the position occupied by the debris of the overthrown cliff, we were much pleased to find it more favorably disposed than we could have conceived possible. Instead of occupying the site of the proposed railway at the foot of the cliff, it had by its acquired velocity slid past it, and left comparatively little indeed to be removed. At some considerable distance from the cliff, the fragments appeared to be heaved up into a ridge, higher than any other part, forming a small valley towards the cliff, and another seaward, beyond which a second ridge appeared, when it finally slopes off towards the sea. The chalk was by no means hard, and appeared thoroughly saturated with water. The great bulk of the fragments ranged from about two to perhaps eight or ten cubic feet, although we observed a vast number of blocks, which contained from two to three cubic yards and upwards, one of which was driven some distance into the Shakspeare tunnel without doing injury to the brickwork. There was very little, indeed, of what might be termed rubbish in the mass.

Previous to the explosion, we had heard it stated that about a million yards were expected to be detached; indeed the Railway Times so stated it, on the 21st ultimo, apparantly from authority, and after the explosion took place, it was publicly asserted by one of the officials, that three quarters of a million of cubic yards had come down. Now, on cubing the stated dimensions of the mass, which were given as under 300 feet in height by say 50 feet longer than the gallery, which would therefore be 350 feet, by an average thickness or depth from the face of the cliff of 60 feet, we shall have 233,333 cubic yards; but as the present face slope of the cliff is greater than before, the average thickness perhaps might be increased to 75 feet, which would make the quantity 291,666 cubic yards, from this is to be deducted 50,000 yards, the estimated quantity to be now shifted in forming the road, we shall then have 30,000 yards effectively removed by the expenditure of one ton of powder. We understand that Mr. Cubitt, the engineer, afterwards stated that a saving of six months' work and £7,000 expenditure was effected by this blast. Now allowing 6d. per yard for the removal of the quantity now

required to be shifted, which would amount to £1,250, and £500 for the powder used in the blast, the cost of forming the galleries, tamping, etc., we shall find that this mass has been removed at a cost of 1·44 pence per yard. Again, taking Mr. Cubitt's statement, that a saving has been effected of $7,000, to which, if we add the £1,750, expenditure by the present plan, we shall find that he estimated the cost of removal by hard labor, at rather less than 7½d. per yard.

We felt an interest in examining the beds and fissures of the chalk in the neighborhood of this blast, which clearly indicated that the plan of removal adopted by Mr. Cubitt, was not only the cheapest, but the safest method which could have been adopted. The vertical fissures which here traverse the chalk appear to lie pretty nearly parallel, and at a slope perhaps of one-fifth to one-tenth to one. It was in one of these fissures that the whole mass parted and slipped down, on which we believe it had set previously, no doubt brought about by the infiltration of water more than the sapping of the base by the sea. So treacherous, indeed, was this chalk, that if we are rightly informed, a mass equal nearly in bulk to that blasted on Thursday came down unexpectedly some time since in the night time, burying in its ruins a watchman or foreman belonging to that part of the line. In the zigzag gangways cut along the face of the cliff, to enable persons to ascend to the summit—this sliding of the chalk where those vertical fissures are intersected, appears very frequently, inspiring the passer-by with a feeling of great insecurity. How far the water might be intercepted, or otherwise be prevented from filtering through these fissures is a question of great importance, and would not, we think, be one of difficult remedy. It also becomes a matter of interesting inquiry as to the effect which a lesser quantity of powder would have had, deposited and fired in the same manner. Would it only have made the mass insecure, or caused a partial sliding down, rendering it then more difficult of removal by hand than at first? The proportion of powder which Mr. Cubitt employs in his blasting operations we understand is determined thus: "The cube of the line of least resistance in feet, gives the quantity in half ounces;" but in this case there does not appear to have been any such quantity employed, though much more than heretofore is found necessary in usual blasting operations. Perhaps the most curious circumstance, connected with the operation, was the apparent absence of shock on the firing of the charge on some spots in the immediate vicinity, while at other, far more distant, it was clearly perceptible. Thus, where the batteries were placed, those in charge of them thought the charge had missed fire, from their being insensible to any shock, while at five times the distance along the face of the cliff, it was clearly felt. But even along the face of the cliff it was very evident that the shock was felt by some and not by others, though standing within a few yards of each other.

Junction of the Rhine and Danube.—The canal connecting these two great rivers of Europe, was nearly completed at the last accounts. It was to have been opened for navigation in a few days, between Nuremburg and Bamberg, and shortly after, through its whole extent, from Danube to Mayn.

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